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OVERBURDEN ANALYSES AND STRIP-MINE CONDITIONS IN MIDEASTERN OHIO

BY

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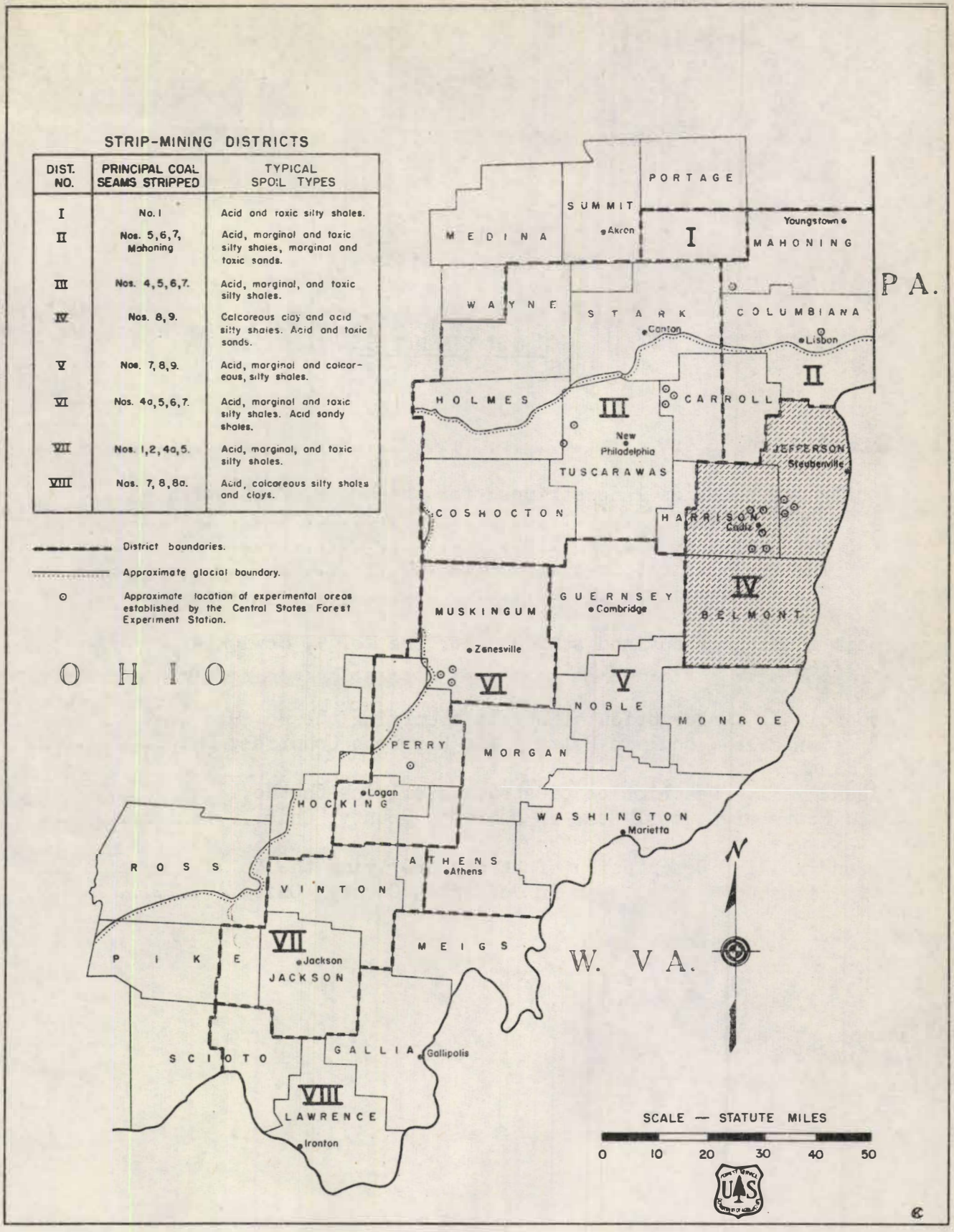

Frontispiece--The coal-mining region of Ohio. Shaded area on map indicates location of strip-mining district described in this report.

OVERBURDEN ANALYSES AND STRIP-MINE CONDITIONS IN MIDEASTERN OHIO

(Strip-mining District No. IV. Belmont, Harrison and Jefferson Counties)

by

G. A. Limstrom

INTRODUCTION

Conditions affecting reclamation measures for strip-mined lands in Ohio vary considerably with the coal seam removed and locality. Each area requires a distinctive treatment, and the practitioner needs detailed information to aid him in the proper choice of possible uses for these lands. A basic classification of spoils of general application in the Central States Region, together with detailed forest planting recommendations on strip-mined lands in Ohio, has already been published.1/ A description of site conditions on specific areas may prove helpful in developing planting plans and may serve as an index of probable site conditions on future strippings for a given locality and coal seam.

The coal-mining region of Ohio has been subdivided into eight strip-mining districts (frontispiece). Although there is some overlapping of characteristics, spoil conditions in each district are sufficiently distinctive to make the district a convenient unit for detailed descriptions of strip-mine reclamation problems in the state. A reconnaissance of lands stripped for coal was made from 1945 to 1947. Each area was examined to determine spoil texture, acidity, and other conditions affecting plant growth. A record of these conditions was made, and a map of the area was prepared. In addition, the "high-walls" adjacent to most strippings were carefully examined and described stratigraphically. Samples of spoil surfaces and of each stratum found in the high-walls were collected for laboratory analyses.

One purpose of this report is to make a record of these detailed reconnaissance data for Strip-Mining District No. IV. This district includes the Pittsburgh, No. 8, and Sewickley, No. 9, coal fields in Belmont, Harrison, and Jefferson Counties, Ohio. Another purpose is to contribute

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1/ G. A. Limstrom, Extent, Character, and Forestation Possibilities of Land Stripped for Coal in the Central States. Central States Forest Experiment Station, Technical Paper No. 109. Mult. 79 pp. December 1948.

---------- and R. W. Merz, The Rehabilitation of Lands Stripped for Coal in Ohio. Central States Forest Experiment Station, Technical Paper No. 113. December 1949.

to the general knowledge of Ohio geology by making a permanent record of the stratigraphic data.

The examination of strip-mined lands in Harrison and Jefferson Counties was made during the period between September 1 and December 31, 1945. Strip-mined lands in Belmont County were examined in August and September, 1947. At the time of these examinations an estimated 785 and 1,020 acres of land in Belmont County had been stripped for the No. 8 and No. 9 coals, respectively. In Harrison County the totals were 8,283 and 348 acres for these coal seams. In Jefferson County 6,252 acres of stripped lands resulted from the mining of the No. 8 coal. The total stripped area in the district represents about 46 percent of the total area in the state that has been strip-mined for coal.

SPOIL CONDITIONS ON LAND STRIPPED FOR THE NO. 8, PITTSBURGH, COAL

Spoil conditions resulting from the mining of the No. 8, Pittsburgh, coal seam are so inextricably related to the character of the overburden that the two subjects will be discussed concurrently.

A generalized section2/ of rocks directly over the No. 8 coal in Ohio includes the following strata:

Bed and member	Thickness	
	Feet	Inches
Clay shale, calcareous	3	0
Sandstone, Lower Sewickley	19	6
Coal, persistent, thin, Fishpot	0	7
Limestone and marly shale, Fishpot	32	1
Coal, unsteady, Redstone, Pomeroy	1	4
Limestone and marly shale, Redstone	13	0
Sandstone, local, Upper Pittsburgh	9	0
Coal, persistent, Pittsburgh, No. 8	3	7

2/ Wilbur Stout, Generalized Section of Coal Bearing Rocks of Ohio. Geological Survey of Ohio, Fourth Series, Information Circular No. 2. Columbus, 1939.

In Belmont, Harrison and Jefferson Counties, however, the stratigraphy is variable. This variation stems mainly from replacement of the limestone members by sandstone and shale in certain, fairly-well-defined localities. Because of this variation in overburden, three broad classes of spoils have resulted: (1) the limestone-clay spoils, (2) the shaly limestone-clay spoils, and (3) the acid spoils.

THE LIMESTONE-CLAY SPOILS

These banks are composed almost entirely of limestone, clay, and clay shale. At the time of the reconnaissance they were found only in one locality, near Georgetown in Short Creek Township, Harrison County, chiefly between the South Fork and Middle Fork of Short Creek. In this area, both the Redstone and Fishpot limestone members are thick and massive (table 1). Except for the area between and near the confluence of these two streams, none of the many high-walls examined in the district was composed of thick, massive beds of both the Redstone and Fishpot limestones. It should be noted that the Upper Pittsburgh sandstone member is absent in this locality.

Immediately after stripping, the limestone-clay spoils usually contain a high proportion of limestone boulders. In 3 or 4 years, however, weathering has proceeded rapidly enough to provide enough "soil" (50 percent of surface spoil composition) for easy planting. The resulting spoil type is almost invariably a calcareous clay with generally a greater amount of available phosphorus and potash than the original topsoil of the stripped area. The high proportion of clay and the low proportion of shale in the spoil mass accounts for the fact that these banks are relatively compact and impermeable (table 2). Grading operations on these spoils tend to make these lands still more compact and impermeable. The banks formed usually have steep slopes and relatively great relief. On steep slopes having an especially high proportion of clay, slipping of entire banks is apt to occur. This is particularly true where distinct cleavages are caused by the seepage of water.

Although toxic spoils are at present almost nonexistent in the Short Creek area, there is some possibility of their occurrence in future stripping. If in the mining process the Redstone coal--which is not recovered--is placed on top of the banks, the spoils may become nonplantable.

THE SHALY LIMESTONE-CLAY SPOILS

Most of the strip-mined lands in the district resulting from the mining of the No. 8 coal can be classed as shaly limestone-clays. They differ from the limestone-clays in that they contain a higher proportion of rather hard sandy and silty shales. Except for the restricted area where the limestone clays predominate, and for small scattered locations on the periphery of the coal field in the district where acid spoils occur, all No. 8 strippings are of this class.

Table 1.--Descriptions and chemical analyses[1] of strata over the No. 8, Pittsburgh, coal in Ohio

(Sample from Section 13, Short Creek Township, Harrison County)

Description of strata (Top to bottom)	Thickness of strata	Acidity of strata	Available[2] phosphorus	Available[2] potash
	Feet	pH		
Soil--brown silty clay loam	1	5.9	Low	Low
Clay--partly shale, brown, blocky structure	3	5.6	Low	Low
Shale--clayey, gray-brown	15	6.6	Medium	Low
Shale--carbonaceous	1	5.8	Medium	Low
Limestone--Fishpot, reddish-yellow, massive	27	-	High	Low
Shale--gray, hard, acidic, clayey, greasy	3	6.8	Medium	Low
Coal--Redstone, shaly	1	5.2	Low	Low
Limestone--Redstone, reddish-gray, massive	20	-	-	-
Shale--gray, mixed with limestone boulders	6	7.0	Low	Low
Coal--No. 8, Pittsburgh	-	-	-	-

1/ The technique used in the chemical analyses is described in the following publications:

R. H. Bray, Photometer Method for Determining Available Potassium in Soils. Dept. of Agronomy, Agr. Exp. Sta., University of Illinois, College of Agriculture, Mimeographed Circular No. AG 1275. Sept. 14, 1945.

Charles Y. Arnold, and Touby Kurtz, Photometer Method for Determining Available Phosphorus in Soils. Department of Agronomy and Horticulture, Agr. Exp. Sta., University of Illinois, College of Agriculture, Mimeographed Circular No. AG 1306. June 1946.

2/ For soils, the readings "High", "Medium", and "Low" indicate the following quantities per acre:

	Low	Medium	High
	Pounds per acre		
Phosphorus	Less than 53	54-75	More than 75
Potash	Less than 100	100-150	More than 150

Table 2.--Mechanical and chemical analyses of 3-year-old spoil samples taken near stratigraphic section described in table 1

(Section 13, Short Creek Township, Harrison County, Ohio)

Sample No.1/	Proportion of stone	Soil fraction2/			Acidity	Available phosphorus	Available potash
		Sand	Silt	Clay			
	Percent	Percent	Percent	Percent	pH		
1	44.2	4.6	47.4	52.0	6.4	High	Low
2	42.2	17.8	42.2	40.0	7.6	Low	Low
3	50.0	.8	46.8	52.4	7.9	Low	Medium
4	43.0	4.8	42.8	52.4	6.7	Medium	Low

1/ Depth of sample 0-6".

2/ Mechanical analyses by the Bouyoucos Hydrometer method. Clay fraction represents material in suspension at 2-hour reading, approximately .002 mm. or less.

The overburden differs from that found in areas where limestone clays predominate in that the Fishpot limestone is generally absent, and replaced by sandy and silty shales (table 3). Where this member is present it occurs only as a thin seam or in nodular form; it has been observed in Section 16, Archer Township, Harrison County, in some of the deep strippings in Wayne Township of Jefferson County, and specifically, in the following other locations: Sections 20 and 31, Ross Township, Sections 26 and 36, Smithfield Township, and Section 23 of Warren Township, all in Jefferson County. The Redstone limestone is rather persistent in its massive and thick form except in certain areas on the edges of the coal field; specifically, this member is thin or in nodular form in Section 17, Moorefield Township in Harrison County, and in Section 9, Knox Township, Section 28, Steubenville Township and in Sections 4, 5, and 16 of Cross Creek Township, all in Jefferson County. The overburden for the No. 8 coal in northern Belmont County is similar to that shown in table 3, and the spoils formed are generally shaly limestone-clays.

The shaly limestone-clay spoils are also calcareous, but contain a larger number of small, acid areas than the limestone-clay spoils. Because they contain a higher proportion of fairly hard sandy and silty shales than the limestone clays, they are generally more friable, more permeable and less compact (table 4). The relief and topography are about the same for both classes of spoils. Slipping also occurs on several locations, and is especially serious on steep slopes in Warren Township, Jefferson County.

Table 3.--Description and chemical analyses of strata over the No. 8, Pittsburgh, coal in Ohio

(Sample from Section 2, Wayne Township, Jefferson County)

Description of strata (Top to bottom)	Thickness of strata	Acidity of strata	Available phosphorus	Available potash
	Feet	pH		
Soil--brown silt loam, acidic	1/2	-	-	-
Clay--brown-gray, acidic	9	5.2	Low	Low
Shale--light gray, sandy and micaceous, mixed with sandstone fragments (sometimes massive)	6	4.7	Low	Low
Shale--gray-black, clayey, carbonaceous	14	6.2	High	Low
Coal--Redstone, shaly	1	4.9	Low	Low
Limestone--gray to yellow, massive in upper portion, remainder fragmental	20	8.3	Medium	Low
Shale--gray, clayey	4	8.2	Low	Medium

THE ACID SPOILS

The acid spoils formed by the mining of the No. 8 coal in the district are most varied in composition; they are not calcareous because of the absence of both the Redstone and Fishpot limestones in the overburden. These members are replaced in some locations by massive sandstone and in other locations by sandy or silty shales. The acid spoils, relatively small in area, are located generally in the periphery of the No. 8 coal field in these counties.

In Section 6, Springfield Township, Jefferson County, the spoils are an acid sandy loam. The strata over the No. 8 coal in this locality were found to be as follows: directly over the coal seam 2 feet of hard, blue-gray, carbonaceous shale; over this 15 feet of massive sandstone, 4 feet of sandy shale, and 1 foot of sandy silt-loam soil.

Table 4.--Mechanical and chemical analyses of four typical shaly limestone-clay spoils, Jefferson County, Ohio

Sample No.1/	Age of spoils	Proportion of stone	Soil fraction2/			Acidity	Available phosphorus	Available potash
			Sand	Silt	Clay			
	Years	Percent	Percent	Percent	Percent	pH		
1	12	45.1	3.8	46.0	50.2	4.4	Low	Low
2	12	54.9	10.6	43.0	46.4	7.0	Low	Low
3	22	46.1	22.0	44.0	34.0	5.0	Low	Low
4	12	63.1	9.0	41.2	49.8	7.0	High	Low

1/ Depth of sample 0-6".

2/ Mechanical analyses by the Bouyoucos Hydrometer method. Clay fraction represents material in suspension at 2-hour reading, approximately .002 mm. or less.

In Section 17, Saline Township, Jefferson County, one bank less than one-half mile in length was found with an abrupt change in spoil type. The eastern portion was found to be a shaly limestone-clay and the western portion an acid shaly clay. At the juncture of these two spoil types, which is clear-cut, there is also a distinct difference in the high-wall composition; to the east the wall includes 10 feet of limestone, while to the west of this point, the limestone is replaced by a grayish, sticky, clay shale. Faulting may account for this stratigraphic change because this section is located within the area known as the Somerset Syncline.3/

North of Cross Creek, in Cross Creek and Steubenville Townships, Jefferson County, the Redstone limestone was not found in several high-walls examined, while in others it was present only in nodular form (tables 5 and 6). The limestone was absent from high-walls examined in Sections 3, 9, and 23 of Cross Creek Township; it was found as a thin member or only in nodular form in Section 28 of Steubenville Township and in Sections 4, 5, and 16 in Cross Creek Township. The spoils in this locality are often highly acid and toxic, even though some limestone may occur in the overburden. This condition is due to the practice of placing the highly acid sandy and carbonaceous shales, roof coal, or toxic clay on the tops of banks. The texture of the spoils in this area varies from a sand to a heavy clay.

3/ Raymond E. Lamborn, Geology of Jefferson County. Geological Survey of Ohio, Fourth Series, Bulletin 35. Columbus, 1930.

Table 5.--Description of strata over the No. 8, Pittsburgh, coal in Ohio

(Sample from Section 3, Cross Creek Township, Jefferson County)

Description of strata (Top to bottom)	Thickness (Feet)
Soil--shaly clay, brown, acidic	1
Shale--brown, mixed with heavy sticky clay, acidic	4
Shale--grayish-brown, with some intermixed clay	5
Sandstone--fragmental at upper end, grading into massive form at lower end of section	10
Shale--carbonaceous, mixed with roof coal	4
Coal--No. 8, Pittsburgh	-

In Section 9, Wells Township, Jefferson County, a large strip-mined area, believed to have resulted from the mining of the No. 8 coal, is composed almost entirely of sand. At the time of reconnaissance the pH was generally between 4.0 and 5.5, and the surface was estimated to be 95 percent sand, 2 percent sandstone, and 3 percent shale. The final cut had filled with water, making it difficult to obtain accurate stratigraphic data; it appeared, however, that almost all of the overburden was composed of sand.

On the western edge of the Pittsburgh coal field in Harrison County the Redstone limestone as well as the Fishpot limestone disappears from the overburden. The Redstone limestone exists only in nodular form in Section 17, Moorefield Township, while a short distance farther west, in Sections 22 and 23, it is absent (table 7). In the latter location the spoils are acid, shaly clays.

Table 6.--Description of strata over the No. 8, Pittsburgh, coal in Ohio

(Sample from Section 4, Cross Creek Township, Jefferson County)

Description of strata (Top to bottom)	Thickness (Feet)
Soil--yellowish-brown silty clay, acidic	1
Clay--grayish-brown, acidic, shaly	4
Coal--Redstone, shaly, and fragmental	0 - 1 1/
Clay--gray, sticky, acidic	20
Limestone--gray, not massive	4
Sandstone--shaly, reddish-brown, hard, compact, almost massive	6
Shale--reddish-brown, carbonaceous	4
Coal--No. 8, Pittsburgh	-

1/ Absent in some portions of the high-wall.

Table 7.--Description of strata over the No. 8, Pittsburgh, coal in Ohio

(Sample from Section 22, Moorefield Township, Harrison County)

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown silt loam, acidic	1
Clay--yellowish-gray, sticky, acidic	4
Shale--grayish-black, somewhat carbonaceous, grading locally into sandstone, acidic	18
Coal--No. 8, Pittsburgh	-

SPOIL CONDITIONS ON LAND STRIPPED FOR THE NO. 9, SEWICKLEY, COAL

The No. 9, Sewickley, coal, sometimes known as the Meigs Creek or Mapletown, occurs about 75 to 100 feet above the No. 8 coal on the high hills in Harrison and Jefferson Counties, and in extensive areas in Belmont County. Large-scale stripping for this coal was begun only recently and to date is located in Short Creek and Athens Townships, Harrison County, and in the northern townships of Belmont County.

A generalized section[4/] of the rocks directly over the No. 9 coal in Ohio includes the following strata.

Bed and member	Thickness	
	Feet	Inches
Limestone and calcareous shale, Arnoldsburg	37	0
Shale, green, or shaly sandstone, Fulton	4	0
Limestone and calcareous shale, Benwood	34	4
Sandstone, local, Sewickley	20	0
Coal, Sewickley, Mapletown, Meigs Creek, No. 9	1	10

As in the case of the No. 8 overburden, however, there is considerable variation in the character of the strata over the No. 9 coal. Calcareous strata were observed in several high-walls in Short Creek Township of Harrison County, and Wheeling Township in Belmont County. Westward from these localities, however, the calcareous material is replaced by highly acid shales (Appendix I).

In Short Creek Township the spoils derived from the overburden described on page 12 are generally calcareous, shaly clays that include a sufficient amount of soil to permit easy planting within 2 years after stripping. In section 26 of Wheeling Township the No. 9 spoils are partly calcareous and partly toxic; although there is a sufficient amount of calcareous material to produce good plantable spoils, the toxic shales and sandstone (page 12) have been placed on the surface of the banks over almost 50 percent of the area. In section 21 of Wheeling Township, little

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4/ Wilbur Stout, Generalized Section of Coal Bearing Rocks of Ohio. Geological Survey of Ohio, Fourth Series, Information Circular No. 2. Columbus, 1939.

or no toxic material appears in the overburden, and the spoils are a calcareous silty clay (page 13). In general, the No. 9 spoils east of State Highway No. 9 in this township are much more favorable planting sites than those located west of this road in Belmont County. Most of the No. 9 high-walls examined west of this road had no calcareous material; in its place was 15 to 25 feet of toxic shale and sandstone.

The occurrence of a high proportion of toxic material in the overburden presents a very difficult reclamation problem. Operators of stripping equipment should be made aware of this problem. If practicable, special procedures should be followed in these areas to completely cover the toxic material on the banks. Nontoxic spoils resulting from the stripping of the No. 9 coal are good sites for a wide variety of hardwoods and conifers.

APPENDIX I

Descriptions of strata overlying the No. 9, Sewickley, coal in Belmont and Harrison Counties, Ohio, are found on the following pages:

County	Township	Section	Page No.
Harrison	Short Creek, T9N	26	12
Harrison	Short Creek, T8N	30	12
Belmont	Wheeling	26	12
Belmont	Wheeling	21	13
Belmont	Flushing	3	13

HARRISON COUNTY

Section 26, Short Creek Township, T9N

Description of strata (Top to bottom)	Thickness (Feet)
Soil--gray-brown silt-loam, acidic	1
Clay--brown, acidic, shaly	3
Limestone--gray, massive, grading into a hard, marly clay in scattered spots	24
Shale--grayish-black, carbonaceous, acidic	4
Coal--No. 9, Sewickley	-

Section 30, Short Creek Township, T8N

Soil--dark brown clay, acidic	1
Silt-stone--yellowish-brown, hard, massive, calcareous	12
Limestone--yellowish, in a few spots grading into greenstone (glauconite)	2
Shale--grayish-black with brown mottling, calcareous, with some sandstone intermixed	8
Coal--No. 9, Sewickley	-

BELMONT COUNTY

Section 26, Wheeling Township

Soil and subsoil--varies from a silt-loam to stiff clay, brown, acidic	1
Clay--greenish, calcareous, mixed with nodular limestone and greenstone	4
Limestone--massive, mixed with some calcareous clay and clay shale	4
Sandstone--very fine textured, massive, brown, intermixed with soft thin-bedded silty shale, both toxic	12
Shale--thin-bedded, silty, gray, mottled red, toxic	2
Coal--No. 9, Sewickley	-

BELMONT COUNTY

Section 21, Wheeling Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown silt loam, acidic	1/2
Subsoil--brown stiff clay, acidic	2
Clay--greenish, calcareous, mixed with nodular limestone and greenstone	2 - 4
Silt--yellow, blocky columnar structure, highly calcareous	2 - 12
Limestone--somewhat massive, mixed with calcareous clay shale	10 - 20
Shale--gray, thick-bedded, silty, very hard, slightly calcareous; mixed with acidic, thin-bedded silty shale	12
Coal--No. 9, Sewickley (Only in localized spots in roof coal was any toxic condition found)	-

Section 3, Flushing Township

Soil--gray loam, acidic	1/2
Subsoil--a mottled gray-green and yellow sandy clay	3
Shale--somewhat thick-bedded, sandy, slightly toxic, ferruginous, gray-green to brown	6
Sandstone--gray to brown, massive, acidic, with ferruginous spots, highly toxic	-
Shale--gray-green, silty, thin-bedded, ferruginous, toxic	18
Coal--No. 9, Sewickley	-

APPENDIX II

Descriptions of strata overlying the No. 8, Pittsburgh, coal seam in Harrison County, Ohio, are found on the following pages:

Township	Section	Page No.
Archer, T11N	10	15
Athens, T9N	1	15
German	26	15
Green, T10N	7	16
Green, T10N	10	16
Green, T9N	23	16
Moorefield	17	17
Rumley	32	17
Rumley, T12N	33	17
Short Creek	2	18
Short Creek	7	18
Short Creek, T8N	12	18
Short Creek	14	19
Short Creek, T8N	18	19
Short Creek	20	19
Short Creek	21	20
Short Creek, T8N	24	20
Short Creek, T9N	26	20
Short Creek, T9N	27	21

HARRISON COUNTY

Section 10, Archer Township, T11N

Description of strata (Top to bottom)	Thickness (Feet)
Soil--dark brown silt loam, acidic	1
Clay--gray-brown, shaly	4
Shale--bluish-gray, thick-bedded; some massive sandstone; carbonaceous	13
Coal--Redstone, shaly	1
Limestone--massive, bluish-gray	15
Clay--bluish-gray, marly, calcareous	3
Coal--No. 8, Pittsburgh	-

Section 1, Athens Township, T9N

Soil--dark brown clay loam, calcareous	1
Clay--gray-brown, calcareous, somewhat shaly in spots, intermixed limestone boulders	6
Limestone--yellowish to gray, massive, intermixed with clay	10
Coal--Redstone	1
Limestone--grayish, fragmental, merging into hard marly gray clay; somewhat shaly in places	14
Coal--No. 8, Pittsburgh	-

Section 26, German Township

Soil--brown	1/2
Clay--yellow, shaly	5
Shale--gray-black, lower half carbonaceous	12
Coal--Redstone, shaly	1
Limestone--yellow to gray, massive	15
Clay--marly, shaly	5
Coal--No. 8, Pittsburgh	-

HARRISON COUNTY

Section 7, Green Township, T10N

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown, silt loam, acidic	1
Shale--brown, acidic, mixed with clay and greenstone	4
Shale--massive, black, carbonaceous	12
Coal--Redstone, somewhat shaly	1
Limestone--yellowish-gray, massive	8
Shale--gray, mixed with marly clay and limestone	6
Coal--No. 8, Pittsburgh	-

Section 10, Green Township, T10N

Soil--silt loam, acidic, brown	1
Shale--mixed with clay and fragments of sandstone	4
Shale--grayish-black, carbonaceous	10
Coal--Redstone, shaly	1
Limestone--yellow-brown, massive	14
Shale--gray, mixed with marly clay	6
Coal--No. 8, Pittsburgh	-

Section 23, Green Township, T9N

Soil--brown, silt loam, acidic	1
Shale--mixed with considerable clay, acidic	4
Shale--gray-brown, acidic, grading into sandstone in parts of bank	10
Coal--Redstone, shaly	1
Limestone--yellowish-brown, massive	12
Limestone--gray, marly, massive	3
Shale--gray, marly	4
Coal--No. 8, Pittsburgh	-

HARRISON COUNTY

Section 17, Moorefield Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown silt loam, acidic	1
Clay--reddish-brown, sticky, shaly, with some sandstone	3
Coal--Redstone, very shaly, indistinct	0 - 1/2
Clay--marly, intermixed with limestone nodules	12
Limestone--reddish-brown, fragmental, intermixed with clay	4
Shale--gray, mixed with limestone pebbles somewhat clayey, carbonaceous	5
Roof coal	

Section 32, Rumley Township

Soil--gray-brown	1/2
Clay--grayish-brown, very shaly	2
Shale--blue-gray, carbonaceous	6
Coal--Redstone, shaly	1
Limestone--massive, grayish, with intermittent pockets of grayish marly clay	12
Clay--blue-gray, hard, shaly	3
Coal--No. 8, Pittsburgh	-

Section 33, Rumley Township, T12N

Soil--brown, silt loam, acidic	1/2
Clay--blue-gray, shaly	2
Coal--Redstone, shaly	1
Limestone--yellowish-gray, massive	10
Clay--very shaly, carbonaceous, blue-gray	5
Coal--No. 8, Pittsburgh	-

HARRISON COUNTY

NE¼NW¼, Section 2, Short Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown, silty clay, acidic	1
Clay--brown, stiff, plastic, acidic, mixed with shale	3
Shale--grayish, mixed with clay, fragmental	10
Coal--Redstone, shaly	1
Limestone--gray to yellow, massive, with clay	12
Shale--blue-gray, somewhat carbonaceous	4
Coal--No. 8, Pittsburgh	-

Section 7, Short Creek Township

Soil--reddish-brown	1
Clay--gray-brown, shaly	4
Limestone--massive, reddish-brown	14
Coal--Redstone, shaly, very indistinct	1
Limestone--grayish	10
Clay--marly	4
Coal--No. 8, Pittsburgh	-

Section 12, Short Creek Township, T8N

Soil--yellowish-brown, silty clay, acidic	2
Shale--reddish-brown, platy, hard	8
Coal--Redstone, mostly shale	1/2
Limestone--yellowish, massive	18
Shale--blackish-gray, carbonaceous	1
Limestone--gray, mixed with hard, gray, marly clay	15
Coal--No. 8, Pittsburgh	-

HARRISON COUNTY

Section 14, Short Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--gray-brown, silt loam, acidic	1 1/2
Limestone--grayish-brown, intermixed with considerable clay and some shale	12
Coal--Redstone, nearly all shale, indistinct	0 - 2
Limestone--intermixed with marly clay and shale	10
Shale--grayish, carbonaceous at lower 1/3 of section	5
Coal--No. 8, Pittsburgh	-

Section 18, Short Creek Township, T8N

Soil--brownish-gray, silt loam, acidic	2
Clay--grayish-brown, shaly, acidic	3
Shale--reddish-brown, platy, hard, acidic, with just a slight blackish color on lower 6" where Redstone coal usually occurs	6
Limestone--yellowish, massive	15
Limestone--grayish, mixed with considerable hard, gray, marly clay	18
Coal--No. 8, Pittsburgh	-

Section 20, Short Creek Township

Soil--gray-brown, acidic, silt loam	1 1/2
Clay--brown, somewhat shaly, acidic	6
Limestone--yellowish to gray, massive	20
Coal--Redstone, very shaly, somewhat indistinct	0 - 2
Limestone--yellowish to gray, marly, massive	15
Shale--blue-gray, calcareous, carbonaceous at lower 1/3	6
Coal--No. 8, Pittsburgh	-

Section 21, Short Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown, silt loam, acidic	1
Clay--yellowish-gray, acidic, shaly	1
Shale--gray-brown, acidic, grading into sandstone in some places in section	4
Coal--Redstone, shaly	1/2
Limestone--yellow to gray, massive	10
Limestone--gray, massive	1
Shale--gray, marly, calcareous, carbonaceous in lower 1/3	6
Coal--No. 8, Pittsburgh	-

Section 24, Short Creek Township, T8N

Soil--brown, silt loam, or silty clay loam	1
Shale--grayish-brown, mixed with clay	1
Sandstone--somewhat fragmental, and shaly, grayish	6
Limestone--massive, yellowish to gray	12
Shale--grayish to black, mixed with calcareous clay and nodular limestone, calcareous	15
Coal--No. 8, Pittsburgh	-

Section 26, Short Creek Township, T9N

Soil--gray-brown silt loam, acidic	1
Clay--brown, acidic, somewhat shaly in spots	2
Coal--Redstone, very shaly, thin	0 - 1/3
Clay--gray, calcareous, stiff, plastic, with occasional limestone pebbles, somewhat shaly in lower 1/3 of section	12
Coal--No. 8, Pittsburgh	-

HARRISON COUNTY

Section 27, Short Creek Township, T9N

Description of strata (Top to bottom)	Thickness (Feet)
Soil--gray-brown	1
Clay--shaly, mixed with considerable limestone boulders	12
Coal--Redstone, very indistinct, shaly	0 - 1/2
Limestone--gray to yellowish-brown, massive	10
Shale--gray with considerable clay and limestone	4
Coal--No. 8, Pittsburgh	-

APPENDIX III

Descriptions of strata overlying the No. 8, Pittsburgh, coal seam in Jefferson County, Ohio, are found on the following pages:

Township	Section	Page No.
Cross Creek	5	23
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Island Creek	12	26
Knox	9	26
	13	26
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Salem	10	27
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Smithfield	23	28
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Warren	18	30
	23	30
	36	30
Wayne	3	31
	8	31
	10	31
	13	32
	21	32
	23	32
Wells	17	33
	35	33

JEFFERSON COUNTY

Section 5, Cross Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--shaly clay, grayish, acidic	3
Shale--reddish-brown, with much clay	3
Coal--Redstone, somewhat shaly	2
Sandstone--reddish-brown and gray	6
Clay--reddish-brown, acidic	4
Limestone boulders--mixed with clay and shale	12
Shale--bluish-gray, grading into coal	4
Coal--No. 8, Pittsburgh	-

Section 9, Cross Creek Township

Soil--shaly clay, grayish-brown, acidic	1
Shale--mixed with clay, brown, acidic	5
Sandstone--laminated, fragmental, sometimes shaly	4
Sandstone--grayish-brown, massive	16
Shale--hard, blackish-gray, carbonaceous	4
Coal--No. 8, Pittsburgh	-

Section 14, Cross Creek Township

Soil--shaly clay, brownish	1
Shale--brownish, mixed with clay	4
Sandrock--hard, stratified, streaks of green, red, and brown	4
Coal--Redstone, shaly	1
Limestone--yellow, massive	10
Shale--blue-gray, with sticky clay, somewhat carbonaceous at lower end	3
Coal--No. 8, Pittsburgh	-

Section 19, Cross Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brownish shaly clay, acidic	1
Shale--grayish-brown, with clay, acidic	3
Sandstone--somewhat shaly, fragmental, brown	3
Shale--grayish-brown, somewhat carbonaceous in spots at lower edge	8
Coal--Redstone, shaly	1
Shale--grayish to black, carbonaceous	1
Limestone--yellow to gray, somewhat massive	7
Shale--grayish-black, carbonaceous	2
Coal--No. 8, Pittsburgh	-

Section 20, Cross Creek Township

Soil--a stiff reddish clay, acidic	1
Shale--mixed with clay, reddish-brown, acidic	6
Sandstone--shaly, grayish, reddish and black in spots, lower portion carbonaceous	7
Limestone--reddish-yellow, somewhat massive	2
Sandstone--blue-gray, hard, laminated	18
Coal--Redstone, with shale	1/2
Shale--blue-gray with some clay, carbonaceous	1/2
Limestone--yellow, massive	4
Limestone--gray, massive, somewhat shaly and carbonaceous at bottom	4
Coal--No. 8, Pittsburgh	-

Section 23, Cross Creek Township

Soil--shaly clay	2
Shale--reddish-brown, with clay	6
Sandstone--gray and brown, laminated to massive	12
Shale--hard, with coal, carbonaceous	3
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 25, Cross Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brownish, stiff plastic clay, with some coarse shale at lower edge, acidic	1
Shale--grayish-brown, platy, with clay, acidic	16
Coal--Redstone, nearly all carbonaceous shale	1
Limestone--yellowish-red, somewhat massive	8
Shale--gray, with much clay, calcareous	5
Coal--No. 8, Pittsburgh	-

Section 27, Cross Creek Township

Soil--a shaly clay, acidic	1
Shale--brown, intermixed with shale, acidic	2
Coal--Redstone, with shale, black	1/2 - 1
Clay--brown, stiff, with some shale, acidic	4
Limestone--fragmental but almost massive, intermixed with some clay	12
Shale--greenish, hard	4
Coal--No. 8, Pittsburgh	-

Section 32, Cross Creek Township

Soil--a brown shaly clay	1
Shale--brown, mixed with clay and sandstone, becoming yellowish in lower 2 feet	5
Shale--blue-gray, rather fragmental	8
Sandstone--reddish-brown, massive	3
Shale--brownish, somewhat platy, becoming gray and carbonaceous at lower end	15
Coal--Redstone, shaly	1
Limestone--reddish-yellow, massive	10
Shale--blue-gray with clay	3
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 12, Island Creek Township

Description of strata (Top to bottom)	Thickness (Feet)
Sandstone--loose, platy, grayish	4
Coal--Redstone, barely visible, mostly shale	1/2
Shale--of heavy clay, grayish, interspersed with thin layers of limestone, calcareous	8
Limestone--massive, reddish-brown	25
Shale--gray, clayey	10
Coal--No. 8, Pittsburgh	-

Section 9, Knox Township

Shale--bluish-gray	12
Sandstone--shaly to massive	12
Coal--with thin shale bands, Redstone	1
Clay--bluish-gray, sandy	6
Clay--shaly	6
Clay--somewhat sandy texture	20
Sandstone--massive	5
Coal--No. 8, Pittsburgh	-

Section 13, Knox Township

Clay--shaly, somewhat stiff	4
Coal--Redstone, usually absent, sometimes visible	0 - 1/2
Clay--grayish, brown mottling, stiff, plastic	10
Limestone--grayish-brown, massive	15
Clay--grayish, stiff, plastic, calcareous	4
Shale--clay, blackish to gray, calcareous	6
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 22, Knox Township

Description of strata (Top to bottom)	Thickness (Feet)
Sandstone--fragmental, mixed with top soil	2
Shale--sandy, grayish and brown	3
Sandstone--shaly, grayish-green and brown	3
Coal--Redstone, mostly carbonaceous shale	1 - 2
Clay--grayish, acidic, heavy, sticky	4
Limestone--brown to gray, fragmental, intermixed with shale and clay	10
Shale--clayey, sometimes carbonaceous. Calcareous except for the carbonaceous fragments	8
Coal--No. 8, Pittsburgh	-

Section 27, Knox Township

Soil--brown, loam, acidic	1
Sandstone--mixed with shale and loam, acidic	2
Coal--Redstone, very shaly	0 - 1
Clay--shaly, gray	4
Limestone--somewhat massive mixed with shaly clay, buff	15
Shale--grayish-black, carbonaceous	3
Coal--No. 8, Pittsburgh	-

Section 10, Salem Township

Soil--brown, silty clay, acidic	1
Clay--light brown, acidic	2
Coal--Redstone, very shaly	0 - 1
Limestone--somewhat massive, yellowish to reddish-gray mixed with considerable calcareous clay	10
Shale--very hard, blue-gray to reddish-brown	4
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 36, Salem Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown, acidic, silt loam	1
Sandy loam--shaly, acidic, brown	3
Sandstone--massive, upper 1/3 mixed with sandy shale, lower portion massive, light brown	25
Coal--No. 8, Pittsburgh	-

Section 23, Smithfield Township

Soil--a brown silt loam, acidic	1
Shale--gray-brown, fragmental, platy, acidic	8
Coal--Redstone, very shaly	1
Clay--yellow, stiff, plastic, acidic in most places, but sometimes mixed with limestone	2 - 3
Limestone--gray to brown, ferruginous, hard	4
Shale--gray-black (roof coal)	4
Coal--No. 8, Pittsburgh	-

Section 26, Smithfield Township

Soil--brown, silty clay loam, acidic	1
Clay--gray-brown, mixed with shale, acidic	2
Limestone--gray-brown, fragmental, mixed with calcareous clay	3
Shale--hard, calcareous, mixed with clay	12
Coal--Redstone, shaly, almost indistinct	1
Limestone--gray-brown, somewhat massive, with clay intermixed	14
Shale--gray, clayey, very hard	4
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 31, Smithfield Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--yellowish-brown clay	1
Clay--yellowish, shaly	2
Coal--Redstone, almost all shale	0 - 1/2
Shale--mixed with clay	1
Limestone--yellow, massive, intermixed with clay	15
Shale--blue-gray, clayey, hard	4
Coal--No. 8, Pittsburgh	-

Section 36, Smithfield Township

Soil--brown, loamy, acidic	1
Loam--brown, mixed with considerable shale, acidic	3
Shale--grayish, fragmental, mixed with occasional fragments of sandstone, acidic	8
Limestone--somewhat massive, yellowish-brown	2
Shale--blue-gray to green, platy, hard, with interfaces of calcareous clay	16
Coal--Redstone, shaly	1
Shale--clayey, dark brown to black	1
Limestone--grayish-brown, somewhat massive	1
Limestone--nodular, mixed with considerable calcareous clay	6+
Talus	12

JEFFERSON COUNTY

Section 18, Warren Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--grayish-brown, loam, acidic	1
Clay--chocolate brown, blocky structure, acidic	4
Coal--Redstone, almost entirely absent, present only in streaks	0 - 1
Limestone--somewhat massive, but intermixed with considerable clay	15
Shale--clayey, somewhat carbonaceous, acidic, and with some roof coal in lower 1/3	6
Coal--No. 8, Pittsburgh	-

Section 23, Warren Township

Soil--brown	1 - 3
Limestone--somewhat massive, but with large masses of clay between limestone laminations	14
Coal--Redstone, indistinct in places, shaly	1
Limestone--gray, massive, mixed with small quantity clay, lower 1/6 somewhat shaly, carbonaceous	12
Coal--No. 8, Pittsburgh	-

Section 36, Warren Township

Soil--dark gray-brown silt loam, acidic	1/2
Soil--brown, silt loam, calcareous	2
Greensand (glauconite)--calcareous, greenish-gray, somewhat silty	2
Coal--Redstone, very thin, shaly, indistinct in spots	1/2
Limestone--grayish, fragmental, mixed with plastic clay	15
Shale--clayey, thin-bedded, calcareous, dark gray	6
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 3, Wayne Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--clay, brown, with some shale	1
Clay--brown, very shaly	3
Shale--gray-brown, rather hard and platy	8
Coal--Redstone, very shaly	1
Shale--brown, with clay	1
Limestone--yellowish to red, fragmental, mixed with clay	8
Shale--blue-gray, with clay, carbonaceous	4
Coal--No. 8, Pittsburgh	-

Section 8, Wayne Township

Soil--brownish, a plastic clay, acidic, somewhat shaly in lower half	2
Shale--yellowish-brown, acidic	8
Coal--Redstone, shaly	1
Shale--dark brown, somewhat carbonaceous	1
Limestone--yellowish and sometimes grayish	12
Shale--hard, bluish-gray, somewhat carbonaceous at lower end	6
Coal--No. 8, Pittsburgh	-

Section 10, Wayne Township

Soil--a stiff heavy, plastic clay, acidic	1
Shale--brown, with clay and occasionally some sandstone, acidic	12
Coal--Redstone, shaly	1
Shale--brown, hard	1
Limestone--yellow to gray, massive	8
Shale--gray, calcareous, hard	3
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 13, Wayne Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--a stiff, plastic, brown clay, acidic	1
Clay--brown, mixed with shale, acidic	5
Coal--Redstone, shaly	1
Shale--fragmental, mixed with clay	4
Clay--hard, yellow, calcareous, mixed with limestone boulders, especially at lower part of section	12
Shale--hard, bluish-gray	4
Coal--No. 8, Pittsburgh	-

Section 21, Wayne Township

Soil--clay, brownish, stiff, plastic	1
Clay--brown, mixed with shale	2
Shale--brown, fragmental, platy	3 - 4
Coal--Redstone, shaly	1
Limestone--reddish-yellow, massive	10
Shale--blue-gray, hard	4
Coal--No. 8, Pittsburgh	-

Section 23, Wayne Township

Soil--stiff plastic clay, brown	1
Shale--gray-brown, with clay	8
Sandstone--platy, almost shaly	2
Coal--Redstone, shaly	1
Shale--gray, mixed with clay and limestone	1
Limestone--yellow, somewhat fragmental	10
Shale--grayish-black, with much clay	3
Coal--No. 8, Pittsburgh	-

JEFFERSON COUNTY

Section 17, Wells Township

Description of strata (Top to bottom)	Thickness (Feet)
Soil--brown, silt loam	1
Coal--Redstone, very shaly	1
Limestone--yellow, massive, mixed with clay	12
Shale--blue-gray, hard, with clay	5
Coal--No. 8, Pittsburgh	-

Section 35, Wells Township

Soil--silt loam, acidic, brown, mixed with shale at lower end	3
Shale--gray-brown, loose on upper 1/3, lower 2/3 hard platy	6
Coal--Redstone, shaly	2
Shale--gray-brown, hard, platy	1
Limestone--buff color, mixed with clay, somewhat massive	8
Clay--blue-gray, very hard, somewhat carbonaceous and shaly, acidic	4
Coal--No. 8, Pittsburgh	-

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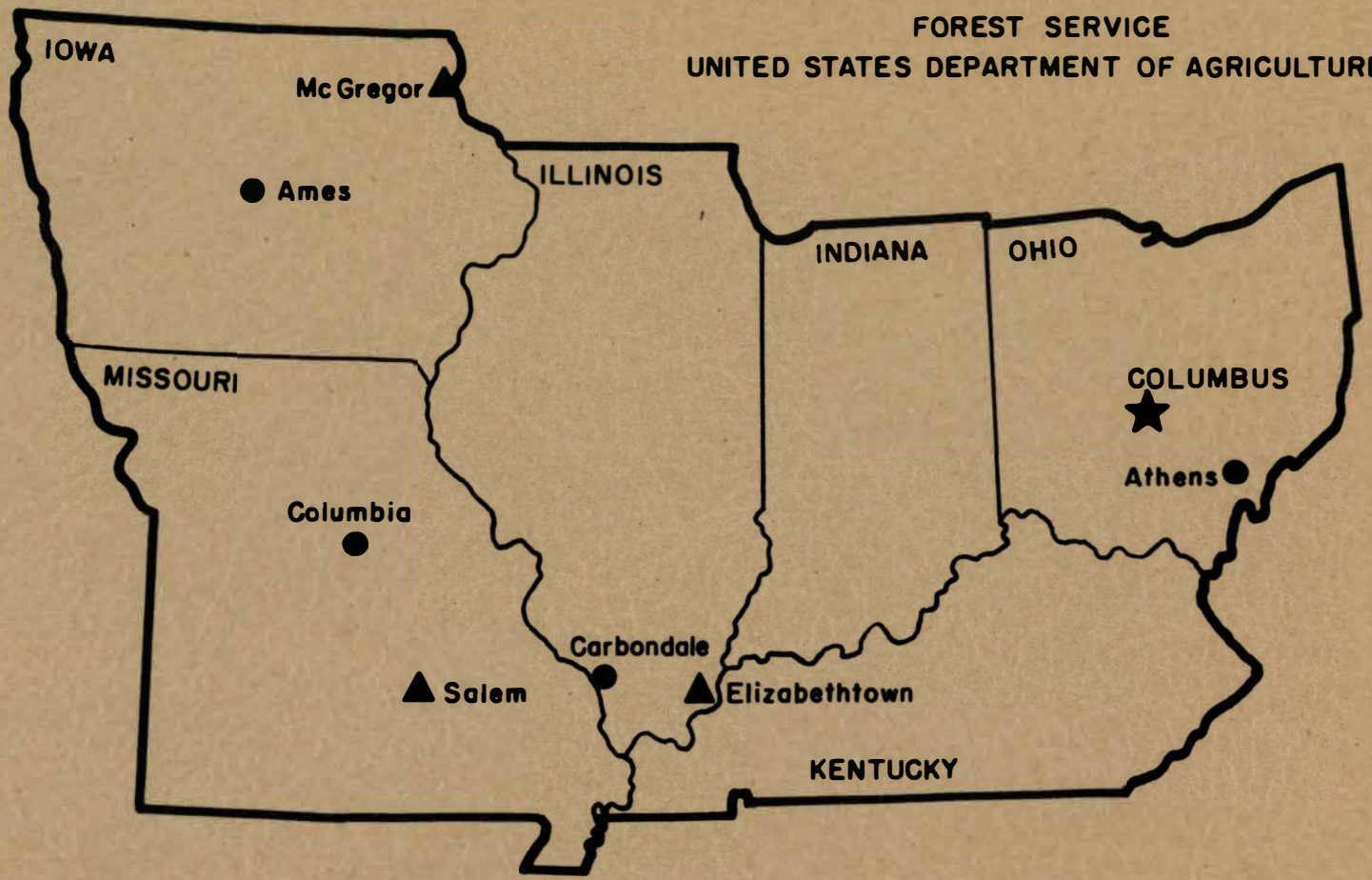

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